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Determinants of a global financial center: An exploratory analysis

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Abstract

Well designed and comprehensive analyses of identifying determinants for a global financial center (GFC) are limited. This study is conducted to examine and identify the fundamental determinants for the Asia-Pacific region. Current literature provides us with 14 determinants which have been used in previous academic studies. The relevance and importance of these determinants for the Asia-Pacific region are unclear. We form 16,384 models on these 14 determinants to test the appropriateness of each of these determinants. Unlike previous studies, we use both Bayesian averaging of classical estimates (BACE) and the weighted average least square (WALS) in our analyses to ensure the robustness of the findings. Two key criteria are used to select relevant models with appropriate determinants. When all criteria and techniques are jointly considered, three fundamental determinants are identified for the Asia-Pacific region: (i) freedom to trade internationally; (ii) higher education and training; and (iii) market size.

1. Introduction

The world has observed the formation and advancement of metropolitan cities in the earliest twentieth century. Theories have been developed by many urbanists in determining cities which provide significant effects on the global economy. Gras (1922) and McKenzie (1927) mention the social and geographical characteristics of the world cities, which are demonstrated to influence the remaining parts of the world. Almost 40 years later, Peter Hall (1966) provides the taxonomic hierarchy of financial cities where New York and London claim the first and second major and largest centers in the world stage. Following the advancement of technological information and the globalization process, Sassen (1991) proposes the concept of a global city by connecting it with cross-border activities such as finance and specialized sectors (telecommunications and multimedia). Previous literature defines a global financial center (GFC) as a central city whose capital market and financial market are synchronized with the flows of global capital, information and telecommunications.

The twenty-first century has witnessed the two decades with a dramatical increase in the GFC establishment. One facet stemmed from urban research is in relation to competition among cities. Following the findings of Buck et al. (2002), the competition between cities for promoting themselves as the attractive havens for inward investments becomes fiercer and more popular. With enormous foreseen advantages of being a GFC such as boosting wealthiness, increasing jobs, city competition has gone worldwide than ever. Cassis (2006) and other economists agree on the significance of historical

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trade links, historical financial connection and financial development on the status of the GFC.

Yildirim and Mullineux (2015) consider that the presence of financial center is symbolic to a host country in terms of financial and industrial services, fascinating infrastructure and technologies, and a major contributor to the national GDP. It can be easily observed that Shanghai, Beijing, Shenzhen, Hong Kong and Guang Chou are not only the five largest cities of China (in terms of GDP contributions as well as financial development) but also these cities belong to the top 10 largest financial centers in Asia Z/yen Group, 2018. Tokyo is also a major GDP contributor to Japan, and the city is currently one of the most well-known financial centers in the world Z/yen Group, 2018. With the focus on the Asia-Pacific region, Sydney and Melbourne are also the major GDP contributors of Australia and these Australian cities belong to the top 10 largest financial centers in the Asian region Z/yen Group, 2018.

We consider that a global financial center allows a country to maintain the steady-state of the economic growth and development. It is because the GFC provides the infrastructure for investment and savings that enable more opportunities for entrepreneurial endeavors. The financial centers aim to address the global funding shortages, which are projected to be at peak for the next 10 or 20 years. Many different economic issues have emerged as part of the globalization and industrialization process, including financial access and integration, energy security, global warming, ageing population and environmental degradation. These issues have become new challenges, and they have also become more crucial for the satisfaction of economic and social demand. It is widely acknowledged that the banking and finance systems are generally considered blood vessels for the entire economy and international trading. The GFC seems to be one way to tackle the issues of financial development and integration. That is a reason we believe analyses to identify the fundamental determinants of a GFC are of utmost importance.

With these advantages of being the GFC, numerous countries in Asia are in pursuit of the financial center such as Indonesia, Thailand, Vietnam, the United Arab Emirates and many others. Yeouido island was schemed as a financial center by the Korean government in 2009. Seoul metropolitan government has cultivated Yeouido to be one of the world's leading financial centers in the world. In order to achieve the target, the governments have put countless efforts on improving the financial industry to achieve the international standard Z/yen Group, 2020. The Turkish Government presents the long-run vision and strategy for Istanbul under the name of "The Istanbul GFC project". Similarly, Dubai was established in 2004 with the ambition of becoming the foremost global financial center, under the guidance and support of His Highness Sheikh Mohammed bin Rashid Al Maktoum, Vice President and Prime Minister of the UAE and Ruler of Dubai Z/yen Group, 2019. Finally, back to 2001, the Politburo of Vietnam identified the financial services sector as one of the most crucial and smokeless sectors for Ho Chi Minh City to become a national financial center. This ambition was once again strongly recognized by Vietnam's Ministry of Finance in 2012. In Ho Chi Minh Economic Forum in 2019 with the participants of many international agencies and local ministries, the discussions focus on the establishment of the GFC in Vietnam and Ho Chi Minh City was nominated as the best candidate city in Vietnam. Establishing a global financial center for emerging major cities in the developing and emerging markets is very important, and the issue should be seriously considered and discussed. These discussions motivate us to conduct this empirical analysis with the focus of providing additional empirical evidence, which is still very limited, on the fundamental determinants of a GFC for the governments to consider in a way leading to an establishment of the GFC in the country.

Following this introduction, the remainder of our paper is structured as follows. Section 2 examines and synthesizes relevant empirical analyses. We present the method adopted and data utilized in this study in Section 3. Section 4 of our paper present and discuss the empirical results obtained from this paper. Section 5 concludes and provides implications for policy purposes for emerging and developing countries in the Asia-Pacific region.

2. Literature review

Few studies have been conducted to identify fundamental determinants for a successful global financial center (GFC). Findings from these studies are mixed. We group previous studies on this issue into two areas of academic studies. The first group of researches includes classical studies which only utilize one dimension to define and classify world cities. Another group of research covers contemporary studies which consider the world cities as a process of continuing growth with persistent endeavors. As such, their status requires more than just a single-facet assessment. For the first group, many economists have put great effort to define and generalize the novel economic phenomenon in relation to the geography of money and finance. Departing from the seminal work of Peter Hall (1966), studies on the taxonomic determinants for global cities have been investigated.

2.1. A one-dimension consideration of important attributes to the world's cities

In this consideration, we provide a summary of findings from previous studies into four key areas on which the cities qualify for being the global financial cities.

The first area of academic studies is in relation to the cosmopolitan characteristics which are typically favorable by various scholars such as Hall (1966), Kindleberger (1974), Hymer (1972), Heenan (1977), Thrift (1994, 1996) and Leyshon (1995, 1997). In this line of thought, the cities as the global centers are likely those with more serviceable capabilities and influential powers in terms of trade, education, culture and technology. Hall (1966) study is generally considered as a distinctive work on defining world cities based on urban geography. Studies by Kindleberger (1974), Hymer

(1972), Khoury (1989), Jao (1997) and Leyshon (1995, 1997) put attention on the multinational corporates (MNCs) headquarters and activities in the financial centers. These authors argue that the accessibility of the MNCs to advanced financial markets, skillful workforce, media and the governments is important in making high-level decisions on coordinating the financial capital flows. Leyshon (1995, 1997) specifically point to the political and economic policies which affect the efficiency of the financial market. Social factors such as social security and living standard have also had their effect on the success and the status of the financial centers. In addition, Khoury (1989) argues that political salience and geographical constellation are the two core drivers of the formation of global financial centers. Thrift (1994, 1996) focuses on the culture and cosmopolitan characteristics which explain the formation of the major cities. The author considers financial centers as the collective means of generating, processing and providing information on the financial market derived from the day-to-day functions of the world economy. Jao (1997) also presents a clear definition of the financial center where the head offices are located. The author emphasizes on the essence of the financial market development in enhancing currency and capital market effectiveness.

The second line of thought considers the world cities as the control centers of capital in the international specialization. Enriching theoretical literature comes from various studies including Cohen (1981), Friedmann and Wolff (1982), Friedman (1986), Godfrey and Zhou (1999), and Glickman (1987). Cohen (1981) study provides us with many possible trends in the new international specialization and urban hierarchy. On the rising demands of MNCs for financial services such as banking, auditing, accounting and legal consultancy, the study links those increasing demands to the change in the nature of the third-party companies which provide those services and the emergence of new major cities. The study considers New York, Tokyo, London as three predominant world-class centers of finance. Following these top cities, other cities such as Chicago, Paris, Frankfurt and Zurich belong to the second tier of the urban hierarchy. Friedman (1986) provides us with the list of leading cities in the world on the basis that the major cities are the control centers for capital in the new era of international specialization. These cities have to satisfy sets of criteria in advance. Moreover, the author also argues that it is almost impossible for delineating a stable urban hierarchy. In relation to Friedman (1986) urban hierarchy, London, Miami, Paris and Osaka-Kobe are considered as the world top-notch centers.

The third line of thought contextualizes the formation of major cities by considering the inter-relationship between the advancement of telecommunication, the globalization, the organizational structure of the financial institution and producer services. Sassen (1991), Zelizer (1994), Dodd (1995), Beaverstock et al. (1999) and Falzon (2001) are generally considered representative studies to this line of thoughts. Dodd (1995) discusses five properties for the monetary network including accountancy, regulation, spatiality, sociality and reflexivity. The author argues that the monetary network

should be best originated through the transmission of information between economic entities. The first two properties are the prerequisites for the formation of a financial network because these properties require a formal or standardized accounting system and legal information. The last three properties imply that financial centers are a combination of financial transactions. Beaverstock et al. (1999) discuss the roster of the world's leading cities in terms of selected services which they can possibly supply. The authors argue that the world's dominant cities are the post-industrial production sites in which the corporates and financial institutions adjust their products and financial services to integrate them with a globalization. The authors use the availability and quality of four fundamental services, such as accountancy, advertising, banking and legal services, which are considered crucial to the financial centers. Sassen (1991) supports the ideas that the globalization of the economy shifts the purpose of financial services and various productions to a global scale. The internationalization of production and financial services conceptualize the financial agglomeration in various world's cities. Considering local preferences of the third-party services, Sassen (1991) ranks London, New York and Tokyo as the three largest cities in terms of the high density of producer services. Similarly, Falzon (2001) suggests that the internationalization of production chains, financial services and the importance of the economy of scale are related to the formation of the global cities.

Fourth, major cities are grounded on the relative ranking of the financial network. Typical studies for this line of thought are Reed (1981, 1989) studies. These studies consider that financial development is the crucial attribute for the formation of a city's attraction to capital resources. Using various analytical methods, the authors identify a taxonomic hierarchy, including five levels by which the world's top-tier cities such as London, New York, and Tokyo are defined.

2.2. A multi-dimension consideration of important attributes to the world's cities

There are limited attempts which have been conducted empirically to consider the formation and the determinants of a global financial center. Typical empirical analyses include studies from Tey (2004), Cheung and Yeung (2007), Kayral and Karan (2012), Yildirim and Mullineux (2015), Moosa et al. (2016) and Eichengreen and Shah (2020). Tey (2004) classify the main factors for the formation of a global financial center into five groups. These groups include (i) business environment (such as tax regime, macroeconomic conditions), (ii) the measure of financial development, (iii) the quality of infrastructure, (iv) the skillfulness of labor force and lastly (v) the reputability of a specific city. Cheung and Yeung (2007) consider that the macroeconomic environment and institutional quality act as catalysts of conditioning the centralization of multinational co-operation (MNCs) and hence the establishment of the GFCs. With limited data, the analysis utilizes the dataset of 18 OECD countries over the period 1998−2003. The authors consider the ratio between foreign direct

investment and GDP to denote the size of the host economy in relation to its nominal GDP. Findings indicate that besides the macroeconomic and institutional factors, the standard living and trade liberalization are found crucial to the attractiveness of foreign financial inflows. Kayral and Karan (2012) utilize logistic regression on a sample of 53 differentiated financial center. In addition, the participation of skilful labor force positively correlates to the financial importance of the major centers. Moreover, their findings indicate that the quality of the legal system and property right is the most influential factor for the state and quality of a financial center.

Eichengreen and Shah (2020) group the determinants of financial center's status into five distinct groups. The influential determinants of financial significance include the flexibility, transactional transparency and economic stability. The second set includes the soundness of money, credit rating, and financial stability. The third group includes the cluster of the variables capturing the level of financial development and the value of market capitalization. The fourth group captures technological sophistication. The final group includes determinants accounting for the size of government. However, the empirical evidence did not support any factor or any particular group mentioned above.

Moosa et al. (2016) introduce model uncertainty and a subjective selection of model forms between the status of a global financial center and its determinants. The authors use the *extreme bound analysis* (EBA) to examine model uncertainty and test for the robustness of included variables. Using three hyperparameters for the EBA, including human capital index, capital access index and economic freedom index, the authors examine 3990 models which are equivalent to 190 estimates for each of individual determinants. Two variables are found to be "robust" to the status of a GFC, including (i) occupancy cost and (ii) global competitive index.

Our literature review highlights necessity of the analyses identifying the fundamental determinants for a successful global financial center, in particular for the Asia-Pacific region. The Asia-Pacific region has generally been considered as a global economic powerhouse in the last two decades in the world's economy. Many cities in the region such as Ho Chi Minh City of Vietnam have emerged as major cities in the process of economic growth and integration. Lessons from existing global financial centers such as London, New York, and Tokyo are very important. However, empirical analyses with the focus on the Asia-Pacific region from this study will provide relevant and direct evidence for policymakers of the countries in the region in identifying fundamental determinants for a formation of a successful global center.

3. Methodology and data

3.1. Selecting the hyperparameter

In this paper, our main interest is on the differences between those countries with and without financial centers. As we do not know the form of the true model of an establishment of a GFC, we select determinants which are drawn from

previous studies to be included in the model. We utilize a mixed probit model whose dependent variable GFC_{it} only receives the value of 0 or 1, which denotes whether or not the country i has any global financial center (GFC) in year t. The equation can be expressed as follows:

$$GFC_{it} = \alpha_i + \sum_{l=0}^{T} x_{i,t}\delta_{i,t} + e_{it}$$

where $i \in (1, \ldots, N)$ and $t \in (1, \ldots, T)$, x_{it} is the $k \times n$ row vector that potentially explains the establishment of a GFC of country i in the period t.

We consider that selecting variables is fundamental for the analyses. In this paper, we use many multi-dimensional indicators which are generally considered good representative for independent variables known as determinants of a GFC in our model. These fundamentals are drawn from various studies such as Kayral and Karan (2012), Moosa et al. (2016), and Eichengreen and Shah (2020). It is worth noting that this procedure by conducting multiple regressions are with the purpose to update our prior expectations, meaning that identifying the fundamental determinants for a GFC. Our literature review indicates that 14 determinants have been widely considered in previous analyses. As the starting point, we take into account all these 14 determinants. There are potentially 2^{14} models, or 16,384 different models, as indicated by the statistical theory, to utilize various combinations of these 14 determinants into different estimations. Some of these 16,384 models might happen to be more informative and predictive than others. Our first step is to set out various criteria for filtering out these models, which we believe are the most relevant and appropriate for our purpose. The second step is to involve with averaging out the potential models based on their corresponding prior probabilities. The following two criteria, proposed in Ca'Zorzi et al. (2012), are used for model selection[1]: (i) we select the model with the smallest value of the Akaike Information Criterion (AIC); and (ii) we select the model with the smallest value of the Schwarz Information Criterion (SIC) or Bayesian Information Criterion (BIC).

These above-mentioned criteria are associated with statistical inferences. We select the predictors which are part of these two equations, and they have positive coefficients. Also, our analysis is extended using the weighted average least square (WALS) and the Bayesian averaging classical estimation (BACE). Each of these techniques is briefly discussed below.

3.2. Our research techniques

Various determinants for the establishment of the GFC have been named in previous studies. In response to a number of determinants, Moosa et al. (2016) introduce the extreme bounds analysis to identify factors which are crucial for the status of a GFC. The lower and upper extreme bounds of a

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[1] We greatly appreciate comments from the reviewers for these criteria.

variable are respectively defined as $\beta_{mini} - 2\sigma_{mini}$, $\beta_{maxi} + 2\sigma_{maxi}$, where β_{mini} and β_{maxi} are the minimum and maximum values of the coefficient of variable i. These estimates can be obtained by simultaneously estimating one at times from three different variables of a pool of "suspected" variables. Doing so is equivalent to the decision to select three balls from a pool of K balls and the variable i. σ_{mini}, σ_{maxi} respectively denote the standard deviation of minimum and maximum coefficients. By its definition and procedure, a major setback of the *extreme bound analysis* is its stringent conditions on the validity of the variable. When the upper bound and lower bound of any specific variable lie on the different side of zero, then the variable is labelled as "fragile". The problem is well articulated in Durlauf and Quah (1999), Sala-i-Martin (2004) and further extended using the method of Granger and Uhlig (1990) generally known as the reasonable extreme bound analysis. Two strands of techniques can be used in tackling the model uncertainty, generally known as the Bayesian and non-Bayesian methods. In this paper, we focus on the other strand, which is the Bayesian approach. Many methods have been developed and widely applied in addressing model uncertainty. Standing out among the Bayesian techniques for flexibility and simplicity, the weighted average least square (WALS) and Bayesian averaging of classical estimates (BACE) are highly regarded and widely utilized. In this section, we use both techniques and then compare the findings to ensure the robustness of our findings.

3.2.1. The weighted average least square

We assume that the variable of interest can be expressed as $y = X_1\beta_1 + X_2\beta_2 + \varepsilon$, where X_1 is a matrix of k_1 column vectors which we believe to appear in the true model. X_2 is the auxiliary matrix of k_2 column vector which may or may not combine with X_1 to determine our variable of interest y, ε is $n \times 1$ column vector of disturbance which is expected i.i.d and normally distributed $\varepsilon \sim N(0, \sigma^2 I_n)$. The WALS method assumes that we can "orthogonalize" the matrix X_2, which means by that $X_2'M_1X_2 = I_{k_2}$, where I_{k_2} is the identity matrix with rank k_2, M_1 is defined as $M_1 := I_n - X_1(X_1'X_1)^{-1}X_1$. In details, we assume that if there is an orthogonal matrix P ($k_2 \times k_2$) which satisfies $P'X_2'M_1X_2P = \Lambda$, it then scales up the auxiliary variables matrix X_2 by $P\Lambda^{-\frac{1}{2}}$, and defines new column vector of coefficient $\beta_2^* = \Lambda^{\frac{1}{2}}P'\beta_2$, then the $X_2^*\beta_2^* = X_2\beta_2$ and $X_2^{*'}M_1X_2^* = I_{k_2}$. We can note that the matrix M_1 is a residual maker of the restricted model (with $\beta_{2i} = 0$) and idempotent matrix. With the assumption of $X_2^{*'}M_1X_2^* = I_{k_2}$, Frisch-Waugh-Lovell theorem says that the least square estimators of β_1 and β_2 in the unrestricted model are $\widehat{\beta}_1 = \widehat{\beta}_{1r} - Q\widehat{\beta}_2$ and $\widehat{\beta}_2 = X_2'M_1y$, where $Q = (X_1'X_1)^{-1}X_1'X_2$ is the correction vector for omitted variables bias or the coefficient vector obtained from the regression between X_1 and X_2.

Let S_i be a ($k_2 \times k_{2i}$) matrix which denotes the selection matrix with full rank column (or linear independence), where $0 < k_{2i} < k_2$ and $S_i' := (I_{k_2 - k_{2i}} : 0)$ is a permutation matrix. For example, with the restricted model ($\beta_2 = 0$), we have $S_i'\beta_2 =$

0. Let $W_i := I_{k_2} - S_iS_i'$ be a diagonal $k_2 \times k_2$ matrix contains k_{2i} ones and $k_2 - k_{2i}$ zeroes. On the basis of the Frisch-Waugh-Lovell theorem of partitioned regression, the coefficient vectors are defined by $\widehat{\beta}_1 = \widehat{\beta}_{1r} - QW_i\widehat{\beta}_2$, and $\widehat{\beta}_2 = W_i\widehat{\beta}_2$. Let λ_i denote the weight of model i which satisfies $\sum_{i=1}^{2^{k_2}} \lambda_i = 1$ and $\lambda_i = \lambda_i(M_1y)$, then the weight matrix W which is $W = \sum_{i=1}^{2^{k_2}} \lambda_i W_i$ in case of $k_2 = 2$ is identical to $\begin{pmatrix} \lambda_1 + \lambda_{12} & 0 \\ 0 & \lambda_2 + \lambda_{12} \end{pmatrix}$. The WALS estimator of b_1 is therefore as follows: $b_1 = \sum_{i=1}^{2^{k_2}} \lambda_i\widehat{\beta}_{1i}$. Magnus et al. (2010), Magnus and De Luca (2014) prove that the expected value of b_1 is $\beta_1 - QE(W\widehat{\beta}_2 - \beta_2)$ if the assumption of "orthogonalization" holds, where $E(W\widehat{\beta}_2 - \beta)$ is the expected value of deviation between estimated coefficients $\widehat{\beta}_2$ and β_2 which are the coefficients of the unrestricted model. Therefore, $var(b_1) = \sigma^2(X_1'X) + Qvar(W\widehat{\beta}_2)Q'$. The variance of b_1 can be simply divided into two parts. The first part represents the variance of X_1 in the estimation between X_1 and y, and the second part is the variance of weighted vector correction bias of $\widehat{\beta}_2$.

3.2.2. The Bayesian averaging of classical estimates

The advantages of utilizing Bayesian averaging of classical estimates (BACE) is clearly outlined by Sala-i-Martin (2004) and later by Magnus et al. (2010). The BACE method does not require any prior selection of the model and also proves useful and flexible in dealing with the exact specification of model and size. First, we present briefly the theories of the prior, likelihood and posterior of the model.

Let M_i denote the exact model, then the log likelihood function of model M_i is the true model given by $\beta_1, \beta_{2i}, \sigma^2, M_i$ is $p(y|\beta_1, \beta_{2i}, \sigma^2, M_i) \propto (\sigma^2)^{-\frac{n}{2}} \times e^{-\frac{S_i}{2\sigma^2}}$, where $S_i = (y - X_1\beta_1 - X_{2i}\beta_{2i})'(y - X_1\beta_1 - X_{2i}\beta_{2i})$ is the sum square error in the unrestricted model between the column vector of the variable of interest y, the matrix of column vector of hyper parameter X_1 and the matrix of column vector of auxiliary variable X_2. As we are certain of X_1 and less certain of X_2's appearances in the true model, the probability of coefficients of β_1 and β_2 given by the true model M_i, σ^2 are $p(\beta_1|\sigma^2, M_i) \propto 1$, $\beta_{2i}|\beta_1, \sigma^2, M_i \sim N(0, \sigma^2 V_{0i})$, where V_{0i} is $k_{2i} \times k_{2i}$ symmetric matrix whose eigenvalues are positive. With the improper prior distribution of σ^2, which is $p(\sigma^2|M_i) = \sigma^{-2}$, we have the joint prior distribution function as follows: $p(\beta_1, \beta_{2i}, \sigma^2|M_i) \propto (\sigma^2)^{-\frac{d_0+k_1+k_{2i}+2}{2}} exp - \frac{h_0\beta_1'\beta_1 + \beta_{2i}'V_{0i}^{-1}\beta_{2i} + a_0}{2\sigma^2}$. Then, the posterior probability function given by the prior is written as $p(\beta_1, \beta_2, \sigma^2|y, M_i) \propto (\sigma^2)^{-\frac{d+k_1+k_{2i}+2}{2}} exp - \frac{R_i + a_i}{2\sigma^2}$, where $d = d_0 + n$, $R_i := \begin{pmatrix} \beta_1 - b_{1i} \\ \beta_2 - b_{2i} \end{pmatrix}' V_i^{-1} \begin{pmatrix} \beta_1 - b_{1i} \\ \beta_2 - b_{2i} \end{pmatrix}$,

$$V_i^{-1} := \begin{pmatrix} X_1'X_1 + h_0 I_{k_1} & X_1'X_{2i} \\ X_{2i}'X_1 & X_{2i}'X_{2i} + V_{0i}^{-1} \end{pmatrix} \text{ and } a_i := a_0 + y'y -$$

$y'(X_1 : X_2)V_i(X_1 : X_2)'y$ which can be rewritten as $a_i = a_0 + y'(M_1^* - M_1^* X_{2i} V_{2i} X_{2i}' M_1^*)y$. By setting the value of $h_0 = 0, a_0 = 0$ and $d_0 = -k_1$, the matrix M_1^* is the residual maker of the restricted model and also idempotent.

Since $\beta_1, \beta_2, \sigma^2$ are continuous random variables, the probability of the data given by these parameters is calculated by taking the integral of posterior probability function in respect to the minor change of $\beta_1, \beta_2, \sigma^2$ which is $p(y|M_i) = \iiint p(y|\beta_1, \beta_{2i}, \sigma^2, M_i)p(\beta_1, \beta_{2i}, \sigma^2|M_i) \times d\beta_1.d\beta_{2i}.d\sigma^2$. We are only left with the prior probability of each possible model to calculate the weight for each model. Previous literature on the BACE is relatively diverse on the reasonable assignment of prior to each model. There are two main solutions to this problem. It is generally agreed on simply giving an equal weight for each model. When we have k_{2i} possible variables that might happen to be in the true model, the prior probability of one specific model is of $\frac{1}{2^{k_2}}$. Brock and Durlauf (2001) cast the denial on the assumption of the presence of a particular variable in the true model is independent of the inclusion of others. This means that the regressors tend to correlate to each other and subject to the research question. In this paper, the prior probability for every model is written as $p(M_i) = \frac{1}{2^{k_2}}$. The weight for any model is given as:

$$p(M_i|y) = \frac{p(y|M_i).p(M_j)}{\sum_{i=1}^{2^{k_2}} p(M_i)p(y|M_i)}$$

where $p(M_i|y)$ denotes the likelihood of model i as a true model given the observed data y which satisfies $\sum_{i=1}^{2^{k_2}} p(M_i|y) = 1$. Thus, the mean and variance of β_1 is calculated as $b_1 := E(\beta_1|y) = \sum_{i=1}^{2^{k_2}} p(M_i|y)b_{1i}$ and $var(\beta_1|y) = \sum_{i=1}^{2^{k_2}} p(M_i|y)(V_{1i}^* + b_{1i}b_{1i}') - b_1 b_1'$, where $V_{1i}^* = var(\beta_1|y, M_i) = \frac{a_i}{n-k_1-2}((X_1'X_1)^{-1} + Q_i V_{2i} Q_i')$, $b_{1i} = (X_1'X_1)^{-1}X_1'(y - X_{2i}b_{2i})$ is the coefficient of β_1 in the unrestricted regression between β_1 and β_{2i}. Similar to β_1, the mean and variance of β_2 are as follows: $b_2 := E(\beta_2|y) = \sum_{i=1}^{2^{k_2}} \lambda_i T_i b_{2i}$ and $var(\beta_2|y) = \sum_{i=1}^{2^{k_2}} \lambda_i T_i (V_{2i}^* + b_{2i}b_{2i}')T_i' - b_2 b_2'$, where T_i is the selection matrix whose each column is linearly independent, $T_{2i}\beta_{2i}$ denotes the ith model and $b_{2i} := E(\beta_{2i}|y, M_i) = (V_{0i}^{-1} + X_{2i}'M_1 X_{2i})^{-1}X_{2i}'M_1 y$.

3.3. Data

The formation of a global financial center, as a dependent variable, is a binary variable. "1" is used when a country has a financial center, and "0" is taken when the country does not have a GFC in the current year. The Z/Yen Group calculates a

Table 1
The top ten global financial centers ranked by the Z/Yen, September 2017.

Top 10 GFC The first in the world	Top 10 GFC in the world	Top 10 GFC in the Asia- Pacific region.
London	New York	Hong Kong
New York	London	Singapore
Hong Kong	Hong Kong	Shanghai
Singapore	Singapore	Tokyo
Zurich	Shanghai	Beijing
Frankfurt	Tokyo	Shenzhen
Sydney	Beijing	Sydney
Chicago	Dubai	Melbourne
Tokyo	Shenzhen	Guangzhou
Geneva	Sydney	Osaka

global financial center index (GFCI) which depends on two sources of data: (i) the instrument variables are collected from many reliable sources; and (ii) survey data are collected from the online questionnaires since 2007. The dependent variable already captures for foreign investors' confidences in the host country's internal policies or the reputation of a global financial center. Another point is that the GFC emerges as the aftermath of the globalization and industrialization process, which requires long term commitment and many efforts from the country. To a certain extent, these accumulative efforts and developments are infeasible to capture. We, therefore, utilize static models by which create the benchmarks and explore the most common determinants between the cities as being the financial cities and those which do not. Our analyses use the dataset of 35 countries in the Asia-Pacific region. Table 1 provides the overall picture of the global financial centers in Asia and the world. The descriptive statistic of all 14 determinants are shown in the Table 3 below.

4. Empirical findings

Table 4 presents findings from the following four models. *First*, as previously discussed, model 1 of our analysis satisfies Criterion 1 - the model with the smallest value of the Akaike information criterion (AIC). *Second*, model 2 meets Criterion 2 - the model with the lowest value of the Bayesian information criterion (AIC). *Third*, model 3 presents empirical findings from our Bayesian averaging classical estimation (BACE) method. *Fourth*, model 4 of our analyses presents results using the WALS techniques.

With respect to model 1 and model 2, six determinants are selected as the hyperparameter for the BACE and WALS techniques, including (i) size of government, (ii) freedom to trade internationally, (iii) market size, (iv) higher education and training, (v) infrastructure and (vi) population density.

Our empirical analysis proposes that many models could be taken into account to identify fundamental determinants for the formation of a GFC. Our analysis is then extended to utilize the BACE and WALS method, which is averaging all of the possible models that could have happened. The third and the fourth column in Table 4 above report the empirical results using the BACE and WALS methods. Findings from

Table 2
Variables.

Determinant	Description
Global Financial Center	Dependent variable takes binary value with one denoting the countries with the GFC.
Size of government	The average of government consumption, transfers and subsidiaries, government investment, top marginal tax rate and state ownership of assets. This variable is measured in the scale of 0−10.
The legal system and property right	The average of juridical independence, impartial courts, protection of property right, military inference in the rule of law and politics, the integrity of the legal system, legal enforcement of a contract, regulatory restrictions on sale and property, reliability of police, business cost of crime. This variable is measured in the scale of 0−10.
Sound money	The average of money growth, the standard deviation of inflation, inflation most recent year, freedom to own foreign currency bank accounts. This variable is measured in the scale of 0−10.
Freedom to trade internationally	The average of income of taxation, non-tariff trade barriers, compliance cost of importing and exporting, foreign ownership/investment restriction, capital controls, freedom of foreigners to visit. This variable is measured in the scale of 0−10.
Business sophistication	This variable takes into account the local supplier quality and quantity, state of cluster development, nature of competitive advancement, the production process of sophistication, value chain breadth, willingness to delegate authority, control of international distribution, the extent of marketing. This variable is measured in the scale of 0−10.
Financial market development	This variable takes into account the financing through equity market, ease of access to loan, venture capital availability, soundness of bank, legal rights index. This variable is measured in the scale of 0−10.
Goods market efficiency	This variable takes into account the intensity of local competition, the extent of market dominance, effectiveness of the anti-monopoly policy, no. Procedure to start a business, no of day to start a business, agriculture policy, total tax rate, prevalence of trade barriers, the prevalence of foreign ownership, the business impact of rules on FDI, import as a percentage of GDP, trade tariff, degree of customer orientation. This variable is measured in the scale of 0−10.
Higher education training	This variable takes into account the secondary education enrollment, tertiary education enrollment, quality of the education system, quality of math and education, quality of management school, internet access in school, availability of research and training services, the extent of staff training. This variable is measured in the scale of 0−10.
Infrastructure	Take into account the quality of overall infrastructure, road, railroad, port, air transport, electricity supply, mobile telephone subscription and fixed telephone line. This variable is measured on the scale of 0−10.
Institution	This variable gives assessments on the property rights, ethics and corruption, undue influence, government efficiency, security, accountabilities and ethics of domestic corporate. This variable is measured in the scale of 0−10.
Labour market efficiency	This variable takes into account the corporate in labor employer relation, hiring and firing practice, the flexibility of wage determination, the effect of taxation on incentives to work, redundancy cost, pay and productivity, reliance on professional management, country capacity to retain talent, country capacity to attract talent, women in the labor force. This variable is measured in the scale of 0−10.
Market size	This variable takes into account the total domestic income, exports as a percentage of GDP, domestic market size and foreign market size. This variable is measured in the scale of 0−10.
Technological readiness	This variable takes into account the availability of latest technologies, firm-level technology absorption, FDI and technology transfer, percentage of individuals using the internet, fixed and mobile broadband of internet subscription, Intelligent internet bandwidth. This variable is measured in the scale of 0−10.
Population density	This variable is computed by taking the number of people per kilometer square of land area.

this BACE method confirm a positive and significant contribution to the establishment of a GFC from the following five determinants, including (i) freedom to trade internationally; (ii) market size; (iii) higher education and training; (iv) size of the government and (v) population density. These five above determinants are also consistent with the results of the WALS estimates. On top of that, *institution quality* is also found positive and significant in the later estimates. The first three determinants are also supported by findings from Model 2 (using the BIC based criterion) and Model 1 (using the AIC based criterion). The remaining two determinants, including *the size of the government* and *population density*, are only supported by Model 1 (using the AIC based criterion).

In summary, across all different techniques as presented in four models 1 to 4, we note that only three determinants

satisfy all four models across techniques. These three determinants are (i) freedom to trade internationally; (ii) higher education and training; and (iii) market size. On these observations, we conclude that these three determinants should be considered as the starting point for the governments to consider the process of formulating relevant economic policies with the purpose of supporting the successful establishment of a global financial center in the emerging markets in the Asia-Pacific region.

5. Conclusions and policy implications

Many cities in the developing economies in the Asia-Pacific region such as Ho Chi Minh City of Vietnam and many others have emerged as the centers for financial and economic activities on a large scale. Governments in those countries have

Table 3
Descriptive statistics of 14 potential determinants of the Global Financial Center for Asian countries.

Name	SoG	LS	SM	FoT	BS	FMD	GME	HET	INF	INS	LME	MS	TR	PD
UAE	6.391	5.930	8.528	8.180	7.186	6.775	7.593	6.994	8.687	7.889	7.180	6.368	7.427	4.786
Armenia	8.137	5.695	9.271	7.836	5.103	5.338	5.893	5.658	5.048	5.333	6.435	3.771	4.802	4.626
Australia	7.017	8.026	9.430	7.579	6.761	7.841	7.080	8.031	7.843	7.702	6.847	7.273	7.789	1.083
Azerbaijan	4.729	5.674	6.822	6.797	5.631	5.443	6.033	5.643	5.709	5.762	6.814	5.136	5.522	4.720
Bangladesh	8.274	3.017	6.723	6.072	4.986	5.516	5.722	3.988	3.436	4.442	5.500	6.341	3.726	7.056
Brunei	4.792	5.438	8.487	7.384	5.485	5.860	5.962	6.128	6.117	6.696	7.077	3.641	5.545	4.327
Bhutan	6.905	6.566	6.863	6.411	5.203	5.227	5.733	5.235	5.026	6.554	6.740	2.642	4.157	2.914
China	4.561	5.902	8.169	6.675	6.248	5.861	6.290	6.131	6.402	6.041	6.541	9.741	5.050	4.969
Cyprus	7.212	6.299	9.052	8.148	6.165	6.144	6.856	6.880	6.947	6.535	6.443	4.072	6.552	4.805
Georgia	7.232	6.004	8.949	8.596	4.888	5.566	6.101	5.481	5.576	5.754	6.653	4.109	4.976	4.188
Hong Kong	8.475	8.100	9.410	9.384	7.398	8.360	8.022	7.467	9.456	8.100	8.056	6.814	8.524	8.824
Indonesia	8.097	4.421	8.812	6.972	6.331	6.161	6.423	6.052	5.386	5.713	5.855	7.668	4.867	4.920
India	8.063	5.377	7.095	6.014	6.350	6.730	6.168	5.702	5.221	5.858	5.853	8.895	4.496	6.051
Israel	6.300	5.976	9.273	8.169	7.102	7.265	6.529	7.249	7.009	6.670	6.722	6.098	7.721	5.902
Japan	6.049	7.488	9.718	7.614	8.292	6.820	7.314	7.543	8.560	7.459	7.050	8.738	7.763	5.858
Kazakhstan	7.135	5.674	8.588	5.906	5.220	5.094	6.044	6.215	5.500	5.537	6.982	6.050	5.487	1.826
Kyrgyz	7.338	4.344	8.454	6.866	4.644	5.070	5.536	5.444	3.811	4.430	5.973	3.701	3.885	3.384
Cambodia	8.146	4.412	9.308	7.324	5.051	5.415	5.954	4.154	4.285	4.993	6.582	4.558	4.231	4.428
Korea, Rep.	6.834	6.469	9.566	7.588	7.069	5.899	6.862	7.739	8.269	5.920	6.133	7.910	7.822	6.245
Lao PDR	6.640	5.844	7.306	6.994	5.371	5.436	6.173	4.773	4.746	5.652	6.509	4.051	4.079	3.328
Sri Lanka	7.335	5.045	7.088	6.485	6.269	6.115	6.340	5.964	5.545	5.727	5.189	5.531	4.639	5.792
Myanmar	6.173	3.287	6.022	4.603	4.148	3.522	5.176	3.549	2.924	4.057	5.946	5.442	2.980	4.366
Mongolia	7.538	5.540	8.202	6.863	4.616	4.654	5.696	5.809	3.731	4.705	6.432	3.649	4.892	0.600
Malaysia	5.964	5.687	7.624	7.497	7.221	7.625	7.329	6.803	7.518	7.034	6.873	6.887	6.320	4.479
Nepal	7.477	3.904	6.438	6.526	4.646	5.391	5.408	4.175	2.908	4.627	5.313	4.395	3.599	5.237
New Zealand	6.539	8.727	9.569	8.653	6.763	8.072	7.550	8.076	7.150	8.559	7.460	5.489	7.743	2.827
Pakistan	7.679	3.533	6.189	6.076	5.410	5.655	5.675	4.087	4.067	4.819	5.018	6.759	4.093	5.492
Philippines	8.376	4.354	9.011	6.924	5.978	5.936	5.858	6.090	4.519	5.006	5.733	6.708	5.019	5.786
Saudi Arabia	4.832	5.269	8.248	6.602	6.667	6.442	6.855	6.552	7.076	7.197	6.196	7.192	6.298	2.604
Singapore	7.400	8.279	9.325	9.270	7.363	8.297	8.138	8.418	9.174	8.687	8.264	6.534	8.412	8.912
Thailand	6.959	5.087	7.455	6.973	6.201	6.416	6.573	6.279	6.626	5.555	6.509	7.249	5.427	4.888
Tajikistan	5.653	5.106	7.873	6.113	5.049	4.709	5.540	5.298	4.010	5.648	6.295	3.633	3.884	4.035
Turkey	6.812	5.105	8.691	7.294	5.992	5.935	6.359	6.108	6.032	5.471	5.083	7.518	5.691	4.577
Vietnam	6.211	5.428	6.069	6.232	5.342	5.590	5.976	5.261	4.961	5.312	6.417	6.645	4.794	5.669

Note: **SoG:** Size of Government; **LS:** Legal system property right; **SM:** Sound money; **FoT:** Freedom to trade internationally; **BS:** Business Sophistication; **FMD:** Financial market development; **GME:** Goods market efficiency; **HET:** Higher education and training; **INF:** Infrastructure; **INS:** Institutions; **LME:** Labor market efficiency; **MS:** Market size; **TR:** Technological readiness; and **PD:** Population density.

put great effort to identify major determinants to ensure the successful formation of a global financial center. However, it appears that few studies had been conducted and the Asia-Pacific region appears to have been largely ignored in current literature. As such, this paper is conducted to provide additional evidence in relation to fundamental determinants for establishing a global financial center in the Asia-Pacific region.

This study uses both Bayesian averaging of classical estimates (BACE) and the weighted average least square (WALS) to overcome the model uncertainty and subjective modelling identified from current literature. 16,384 models on the 14 determinants from current literature have been used to identify the most relevant and important determinants for the purpose of establishing a global financial center in the Asia-Pacific region. Three important determinants are found to be important and relevant for emerging markets in the Asia-Pacific region, including (i) freedom to trade internationally; (ii) higher education and training; and (iii) market size. These three determinants satisfy all criteria and techniques developed and adopted in this paper.

On the basis of the above three fundamental determinants, we consider that the following policy implications are important for the governments of countries in the Asia-Pacific region to consider when relevant policies on the issue are formulated and implemented in the near future. We acknowledge that establishing a successful global financial center is a complicated and multi-faceted decision-making process which requires careful planning. The process also takes into account specific characteristics of the economy and the society. As such, there is no one-size-fits-all approach for different countries in the region. As an illustration, we use Ho Chi Minh City of Vietnam to identify current gaps and relevant targets for the formation of a global financial center.

First, our results indicate that the formation of a global financial center requires an efficient tax system, a good degree of governance, digitalization of bureaucratic works and the trade liberalization. These aspects are embedded in the so-called *freedom to trade internationally* used in our analysis. The financial network should be placed on a standardized accounting system and legal information in relation to the rules, laws and the contractual relationship. Among these

Table 4

14 determinants and their estimated coefficients from our 16,384 models.

Dependent var.	Model 1 (Criterion 1 AIC) GFC	Model 2 (Criterion 2 BIC) GFC	Model 3 (BACE) GFC	Model 4 (WALS) GFC
Size of Government	**0.719*** (2.91)**		0.041*** (2.59)	0.054*** (2.96)
Legal system property right	−0.378 (−1.54)		−0.025 (−0.82)	−0.051** (−2.27)
Sound money			0.002 (0.23)	0.006 (0.30)
Freedom to trade internationally	**1.306*** (3.97)**	**1.268*** (4.31)**	0.106*** (3.43)	0.129*** (3.62)
Business sophistication			0.0006 (0.06)	0.017 (0.45)
Financial market development	−0.971*** (−3.48)	−1.147*** (−4.10)	−0.002 (−0.2)	−0.040 (−1.33)
Goods market efficiency			−0.003 (−0.14)	−0.072 (−1.29)
Higher education and training	**1.539*** (3.68)**	**1.534*** (4.93)**	0.120*** (3.67)	0.134*** (3.85)
Infrastructure	**0.741*** (3.41)**		0.034 (1.35)	0.032 (1.18)
Institutions			0.006 (0.29)	0.088** (2.13)
Labor market efficiency	−0.551* (−1.65)		−0.001 (−0.12)	0.003 (0.11)
Market size	**1.728*** (6.89)**	**1.728*** (6.88)**	0.180*** (13.28)	0.188*** (12.32)
Technological readiness			−0.004 (−0.26)	−0.025 (−1.01)
Population density	**−0.342** (−2.19)**		−0.039** (−3.48)	−0.038*** (−3.38)
Crisis	−0.685 (−1.39)	−0.720 (−1.56)	−0.115** (−2.03)	−0.109* (−1.92)
_cons	−26.042*** (−6.22)	−22.34*** (−7.41)	−2.268*** (−11.17)	−2.354*** (−9.32)
N		374	374	374

Notes: Mixed effect probit model estimation on 14 determinants. Robust t ratios are in parentheses. *A crisis* is a control variable of the model, which is not a determinant of the global financial center. Criterion 1 selects the model with the smallest value of the Akaike information criterion (AIC), *Model 1*. Criterion 2 selects the model with the smallest value of the Schwarz information criterion (SIC), *Model 2*. BACE uses the Bayesian averaging classical estimation, WALS uses the weighted average least square estimates. Since WALS and BACE require the specification of hyper-parameters, we use the variables (1) which are included in *Model 1* or *Model 2*, and (2) yield prior expected signs as expected in Table 2. The binary variable "Crisis" is a control variable and serves as a hyper parameter which receives the value of 1 for the financial crisis in 2008. We note that the 2008 crisis provides a statistically significant and negative impact on the formation of the global financial center.

prerequisites, we consider the efficiency of the tax system and trade liberalization are more crucial. We can observe the success of Hong Kong as a global financial center as a typical example of the *laissez-faire* policy (or free interventionism). In the case of Vietnam, we suggest that the Vietnamese government should optimally minimize the intervention on the market.

Second, we conclude that the essential condition for designating a global financial center is to enhance the accumulation of human capital and the promotion of products and services specialization. The globalization process shifts the scale of local and traditional financial transaction to a global level. Capital flows and modern technologies freely move across nations. This process changes the role of the financial system to make the system to be a collective mean of conveying, generating, processing and interpreting monetary information. As such, the financial system should primarily

focus on the specialization of the skilled labor force, production materials and others. The financial center is effectively the center of "expertise", which requires a certain degree of specialization and skillfulness. In Vietnam, Ho Chi Minh city possesses many potentials and advantages for being a financial center in the Asia-Pacific region. From 2011 to 2017, the proportion of the unskilled workforce has reduced from 38.5 per cent to 21.9 per cent of the total labour force. More astoundingly, the proportion of highly educated workforce grows from 18.9 per cent to 25 per cent. These achievements result from attempts to implement a universal education program. However, weaknesses are found with the Vietnamese educational system. First, our curriculum and programs are obsolete and unfocused. Post-graduate students in Vietnam are not self-confident, non-specialized and low tech in comparison to students in other Asian countries.

Third, our empirical evidence also ascertains that the market size is crucial to market development as well as a financial center establishment. Promoting market size is meant to increase the demand for capital. The following three approaches are recommended for consideration. First, the Vietnamese government should raise more capital for financing infrastructure in particular in the current environment after the Covid-19 pandemic. Many developing countries are successful in doing so. Investing in infrastructure is generally considered a powerful mechanism to increase capital demand. However, it is also a double-edged sword because the mechanism can render the country into a heavily indebted situation with the presence of inefficient management and corruption. Second, the Vietnamese government should promote and support the development of the small-and-medium-enterprises (SMEs) sector. Encouraging entrepreneurship and developing a vibrant start-up ecosystem act as the main channel for financing innovation (Nitin et al., 2017). Lastly, we encourage the Vietnamese government in capitalizing or privatizing the state-owned companies. Doing so is considered fundamental for increasing market demand.

Conflict of interest

This article has no financial nor non-financial conflict of interest.

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